

Ultrasound-Guided Nerve Blocks



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KEYWORDS

• Point-of-care ultrasound • Nerve blocks • Multimodal analgesia • Pain management

KEY POINTS

- Ultrasound-guided nerve blocks can be a primary or adjunctive tool to reduce pain from acute injuries, uncomfortable procedures, or painful conditions.
- Targeted deposition of local anesthetic near specific nerves has been shown to be effective outside of the perioperative setting and is an ideal technique in a multimodal approach to pain management.
- Complications from ultrasound-guided nerve blocks are relatively rare.



Video content accompanies this article at <http://www.emed.theclinics.com>.

INTRODUCTION

Ultrasound-guided nerve blocks (USGNBs) have recently been recognized by the American College of Emergency Medicine as a core component of multimodal pain management for patients in the emergency department (ED).¹ The goals of USGNBs are to provide a multimodal pathway for pain control, offer an alternative to procedural sedation, reduce opioid use, and enhance patient outcomes.^{2,3}

PRE-PROCEDURE PLANNING

Indications

USGNBs can be performed for numerous acute painful conditions, both traumatic and non-traumatic. They can serve as an alternative for procedural sedation for joint dislocation, fracture reduction and large laceration repairs. Additionally, in conjunction with outpatient services, some ED clinicians have started performing blocks for chronic pain as a multimodal opioid-sparing approach.

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Emerg Med Clin N Am 42 (2024) 905–926

<https://doi.org/10.1016/j.emc.2024.05.013>

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Principles of Safety

USGNBs are considered a relatively safe procedure, but any clinician performing this procedure should be aware about the potential complications of USGNBs. Complications can be grouped into 3 major categories: peripheral nerve injury (PNI), local anesthetic systemic toxicity (LAST), and the potential risk of masking compartment syndrome.

Peripheral nerve injury

PNI following USGNBs is relatively rare.⁴ The mechanism of PNI is unclear, with 3 commonly cited theories: mechanical injury from direct needle contact, elevated intrafascicular pressures causing nerve ischemia, and chemical toxicity from local anesthetics. Each theory suggests that intrafascicular injection may increase the risk of PNI.

Most expert clinicians support the use of slow, small volume injections outside the perineurium to reduce PNI. Providers should use low pressure and cease injection if there is pain or paresthesia. Novice providers might consider first injecting normal saline into surrounding fascial planes (hydrodissection) to avoid inadvertent intrafascicular injection. Strict adherence to safe ultrasound-guided needle techniques is crucial, including not advancing or injecting without visualizing the needle tip. Use a block needle or a blunt-tip spinal needle to reduce the risk of PNI. We recommend performing USGNBs only on patients without pre-existing neurologic deficits, and who can undergo a clear neurologic examination.

Local anesthetic systemic toxicity

Local anesthetics typically have a low side effect profile but can lead to LAST when large doses enter the vascular system. The mechanism remains unclear but may be caused by local anesthetics binding to sodium channels in the central nervous system (CNS) and the heart. Clinicians should be aware of the possibility of LAST, recognize the early signs and symptoms, and understand the current accepted treatment.⁵ To avoid LAST we recommend: always staying below the limit of weight-based anesthetic dosing, maintaining clear needle tip visualization during the entire procedure, and aspirating before injecting small volumes (3–5 mL) of anesthetic.

Clinicians performing USGNBs should be aware of the early signs of LAST. Initially, patients may experience CNS excitement like auditory changes, numbness around the mouth, metallic taste and agitation, progressing to seizures, or CNS depression. Cardiac symptoms might precede CNS signs if local anesthetic enters large central arteries, with initial cardiac excitation (hypertension, tachycardia, ventricular dysrhythmia), followed by cardiac depression (bradycardia, conduction blocks, decreased contractility, asystole).⁶ Symptoms typically appear within 1 to 5 minutes post-injection, but timing can vary. We recommend a minimum of 30 minutes of cardiac monitoring post-block, but this may vary depending on local hospital policies.

The American Society of Regional Anesthesia and Pain Medicine recommends a protocol for LAST treatment based on anecdotal and animal data, involving benzodiazepines for acute seizures, and intravenous 20% lipid emulsion for cardiac dysfunction.⁷ Intravenous 20% lipid emulsion should be administered in cases of cardiac dysfunction (eg, dysrhythmia, cardiac depression, hypotension, asystole). The lipid emulsion is believed to bind to the highly lipophilic local anesthetic, and act as a “lipid sink.” Standard Advanced Cardiac Life Support protocols should be followed apart from avoiding; local anesthetic antiarrhythmics, since they can exacerbate the toxicity,

beta and calcium channel blockers since they can further depress cardiac contractility,⁶ and vasopressin given its potential deleterious effect seen in animal models.⁸ The suggested dose is a 1.5 mL/kg bolus of 20% lipid emulsion, followed by a continued infusion of 0.25 mL/kg per minute. An additional 1.5 mL/kg bolus, and an increase of the infusion rate to 0.5 mL/kg per minute can be administered if hemodynamic stability is not achieved. The maximum recommended dose for initial administration is approximately 10 mL/kg for 30 minutes.

Acute compartment syndrome in the setting of ultrasound-guided nerve blocks

The potential of USGNBs to mask acute compartment syndrome (ACS) remains a subject of debate. The controversy arises from concerns that pain relief from an UGNB might obscure the symptoms of ACS.⁹

In cases with a high clinical suspicion for developing ACS, we advise discussing with the admitting and/or consulting service the optimal pain management plan. Single injection USGNBs using short-acting agents, coupled with frequent evaluations or continuous intracompartmental pressure monitoring, could aid in early ACS detection for hospitalized patients.

PROCEDURAL APPROACH

Upper Extremity Blocks

Interscalene brachial plexus block

Indications. The interscalene brachial plexus block provides analgesia for the shoulder and upper arm but may not consistently be effective for pain below the elbow. Its various applications include pain control for proximal upper extremity fractures, draining large deltoid abscesses, managing burns, wound exploration, complex laceration repairs, and an alternative to procedural sedation for reducing shoulder dislocations. One risk of the interscalene block is temporary diaphragmatic hemiparesis, due to phrenic nerve involvement. However, ultrasound guidance has reduced this risk by enabling lower anesthetic volumes and more precise delivery of the anesthetic.^{10,11} The clinical significance of this transient paralysis is unclear, but we recommend not performing this block in patients with compromised pulmonary function (eg, severe chronic obstructive pulmonary disease [COPD], asthma).

Anatomy. The interscalene nerve block targets the brachial plexus at the interscalene groove, located between the anterior and middle scalene muscles, lateral to the carotid artery and the internal jugular vein. This groove is often situated just below the clavicular head of the sternocleidomastoid muscle. Within this groove, the C5-T1 nerve roots are positioned vertically, with C5 being the most superficial root. In some cases, the C8-T1 roots may not have entered the interscalene groove at this level (this may be the reason for inconsistent analgesia distal to the elbow). The most superior aspect of the lung lies caudally and should be visualized to reduce the possibility of puncture.

Technique. Place the patient supine or semi-recumbent, with the head turned toward the contralateral side (away from the injured side and toward the ultrasound screen). If possible, elevate the ipsilateral shoulder by placing a towel or pillow under the scapula to facilitate needle entry when using an in-plane approach.

Place a linear transducer in transverse orientation at the level of the cricoid cartilage (**Fig. 1**) and locate the internal jugular vein and the carotid artery. Slide the transducer laterally to find the clavicular head of the sternocleidomastoid muscle. The brachial plexus roots are in the interscalene groove between the anterior and middle scalene muscles, identified as hypoechoic round or oval structures aligned vertically,



Fig. 1. Transducer position at the level of cricoid cartilage.

resembling a “traffic light” sign (**Fig. 2**). Color Doppler can be used to distinguish these structures from vessels in the neck.

An alternative technique involves locating the brachial plexus at the level of the supraclavicular fossa, and tracing the nerve trunks upwards until the roots are visible in the interscalene groove. Place the transducer parallel to the clavicle in the supraclavicular fossa, moving it downwards until the subclavian artery is seen in cross-section. The brachial plexus, showing a “honeycomb” or “cluster of grapes” appearance, lies lateral to the subclavian artery. Trace the brachial plexus upwards until the roots form the “traffic light” sign within the interscalene groove (**Video 1**).

Identify the C5-7 roots of the brachial plexus and prevertebral fascia, which lies on top of the middle and anterior scalene muscles. Create a small skin wheal about 1 cm lateral to the probe, marking the needle entry point. Insert a 1.5-inch block needle, from a lateral to medial, in-plane approach, advancing the needle tip through the pre-vertebral fascia overlying the middle scalene, taking care to avoid direct needle contact with the nerve roots. Use a small amount of normal saline (2–3 mL) to open this potential space. Anechoic fluid should be noted tracking into the interscalene groove separating the middle scalene from the brachial plexus. Gently administer aliquots of 3



Fig. 2. Nerve roots visualized at the level of the interscalene brachial plexus (ISBP) between the anterior scalene (AS) and middle scalene (MS) muscles, lateral to the carotid artery (CA) and the internal jugular vein (IJV) and below the sternocleidomastoid (SCM).

to 5 mL of local anesthetic. Larger volumes greater than 5 mL increase the risk of phrenic nerve paralysis and Horner syndrome.¹² Keeping the needle tip outside the interscalene groove and hydro-dissecting open the fascial plane will reduce the risk of inadvertent intraneural injection.

Supraclavicular brachial plexus block

Indications. The supraclavicular brachial plexus nerve block (SCB) provides analgesia reliably distal to the level of the mid-humerus. The SCB therefore can be used to facilitate reductions of elbow dislocations and distal radius fractures, as well as management of complex wounds of the forearm. The suprascapular nerve branches proximal to the brachial plexus in the supraclavicular fossa, therefore the SCB does not reliably provide analgesia to injuries of the distal clavicle and shoulder. Compared to the interscalene block, the SCB has a lower incidence of hemi-diaphragmatic paralysis (phrenic nerve involvement) as it is more distal in the brachial plexus.¹³ Color Doppler can be used to distinguish the brachial plexus from surrounding vascular structures to avoid intravascular injection of anesthetic. Pneumothorax is a potential, though rare complication given the proximity of the brachial plexus to the most superior portion of the lung.

Anatomy. The brachial plexus trunks and divisions are tightly arranged in a fascial sheath within the supraclavicular fossa, located above the middle scalene muscle and lateral to the subclavian artery. The subclavian artery is visualized in cross-section as an anechoic round structure at the midpoint of the clavicle, superficial to the first rib. The hyperechoic pleura lies posterior to the first rib.

Technique. Position the patient upright or semi-recumbent, with their head facing the contralateral side of injection. An SCB should be performed using an in-plane approach from a lateral to medial trajectory. The SCB is often a shallow target that can be performed using a standard 1.5-inch block needle, however in larger patients, a longer 3.5-inch block needle may be required.

Place the linear transducer above the upper border of the mid-to-lateral clavicle in a coronal oblique plane, parallel to the clavicle (**Fig. 3**). Slide the transducer medially to find the round, pulsatile subclavian artery, and brachial plexus lateral to the artery (**Fig. 4**). Identify the brachial plexus and create a small anesthetic skin wheal approximately 1 cm lateral to the probe, marking the needle entry point. Insert the block



Fig. 3. The block needle is positioned above the upper border of the mid-to-lateral clavicle in a coronal oblique plane.

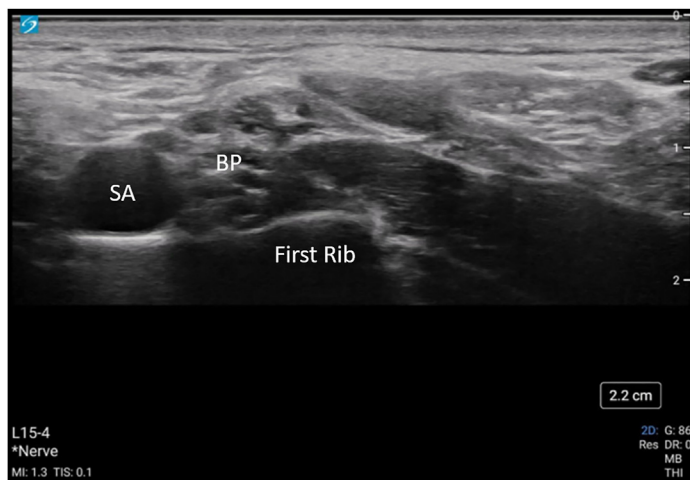


Fig. 4. The brachial plexus (BP) is identified lateral to the subclavian artery (SA) in cross-section and above the first rib at the level of the supraclavicular fossa.

needle from a lateral to medial, in-plane approach. Advance the needle tip toward the lateral border of the brachial plexus, above the first rib, until the needle touches the first rib. Use normal saline to hydrodissect open the potential fascial space above the first rib. Anechoic fluid should push the brachial plexus away from the rib ([Video 2](#)). Be aware that larger volumes greater than 20 mL increase the risk of phrenic nerve paralysis and Horner syndrome, we therefore recommend using a total volume of 10 to 20 mL.¹⁴

Forearm blocks

Indications. The medial, radial, and ulnar nerves supply sensory and motor innervations to the hand. Each of these nerves can be blocked individually or in combination to provide analgesia for a variety of acute hand injuries.¹⁵ Ultrasound-guidance has been shown to result in more effective hand anesthesia than traditional anatomic landmark-based wrist blocks.¹⁶

The median and radial nerves can be blocked for injuries involving the thumb, index, long and ring finger, or radial aspect of the hand ([Fig. 5](#)). The ulnar nerve can be blocked for injuries to the small finger or to the ulnar aspect of the hand (eg, boxer's fracture) (see [Fig. 5](#)). Generally, there is overlap of the distributions of innervation for each nerve, therefore injuries located close to transition zones between sensory nerve distributions may require both nerves to be blocked for adequate pain control. The forearm nerve blocks do not provide analgesia to the wrist or to the volar aspect of the forearm.

Anatomy. The median nerve travels along the midline of the anterior compartment of the forearm between the flexor digitorum superficialis and the flexor digitorum profundus. The median nerve provides sensory innervation to the following: radial/lateral aspect of the volar hand; volar surface of the thumb, index and long finger, and radial/lateral side of the ring finger.

The radial nerve divides into a deep and superficial branch at the level of cubital fossa, the latter of which is the sensory branch. The superficial branch of the radial nerve travels lateral to the radial artery. The radial nerve provides sensory innervation

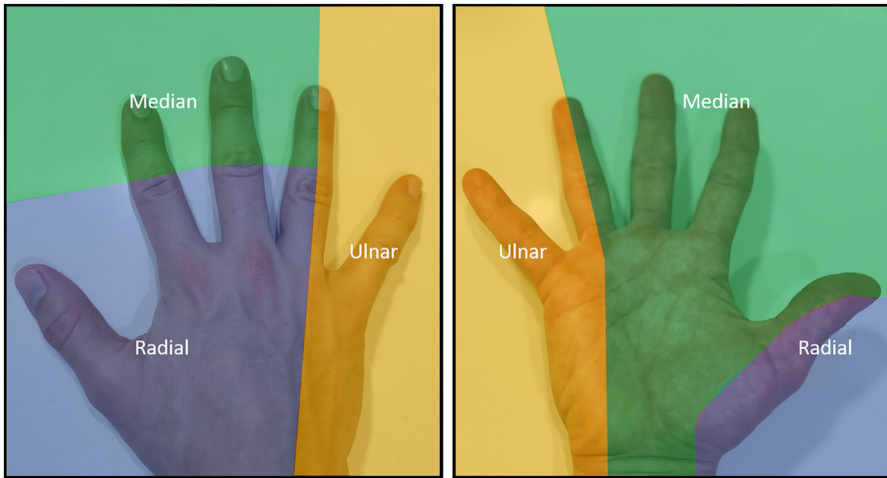


Fig. 5. Dermatomal sensory distribution of the hand.

to the following: radial/lateral aspect of the dorsal hand; dorsal surface of the thumb; dorsal surface proximal to the distal interphalangeal joints of the index and long finger, and radial/lateral side of the ring finger.

The ulnar nerve travels in the anterior compartment of the forearm, deep to the flexor carpi ulnaris muscle and lateral to the ulnar artery. The ulnar nerve provides sensory innervation to the following: ulnar/medial aspect of the dorsal and volar hand including the hypothenar eminence, small finger, and ulnar/medial aspect of the ring finger. The patient can be positioned with the elbow flexed and the wrist externally rotated on a flat, supported surface to facilitate needle entry for the ulnar nerve block (**Fig. 6**).

Technique. Place the patient in a supine or 45-degree upright position with the upper extremity abducted and supinated, resting on a flat surface. The median nerve lies along the midline of the forearm between the flexor digitorum superficialis and the flexor digitorum profundus (**Fig. 7**). Place a high-frequency linear transducer on the



Fig. 6. The patient's elbow is flexed and forearm externally rotated while supported to facilitate needle entry.

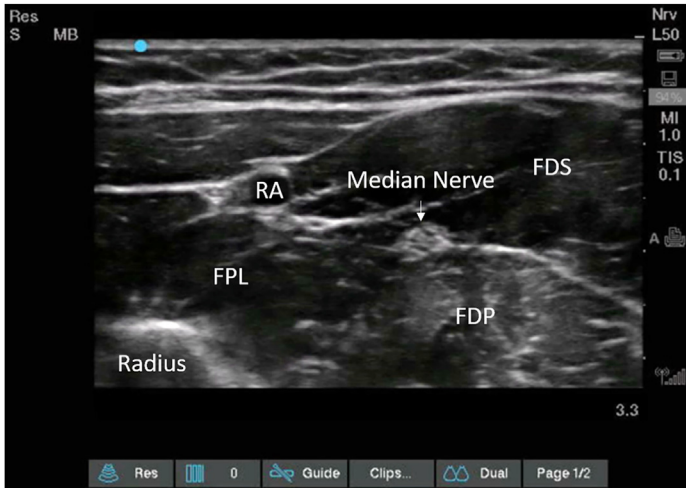


Fig. 7. The median nerve travels between the flexor digitorum superficialis and the flexor digitorum profundus, and is medial with respect to the radial artery (RA) and the flexor pollicis longus (FPL).

volar surface of the distal forearm in a transverse orientation. Slide the transducer proximally toward the mid-forearm and look for an oval shaped hyperechoic structure, classically described as honeycomb-like in appearance. Unlike the radial and ulnar nerve, there are typically no vascular structures surrounding the median nerve. Differentiation of the median nerve from adjacent tendons and connective tissue in the distal wrist can be challenging due to their similar honeycomb-like appearance. By scanning more proximally along the mid-forearm, tendons will disappear and the nerve will become easier to identify.

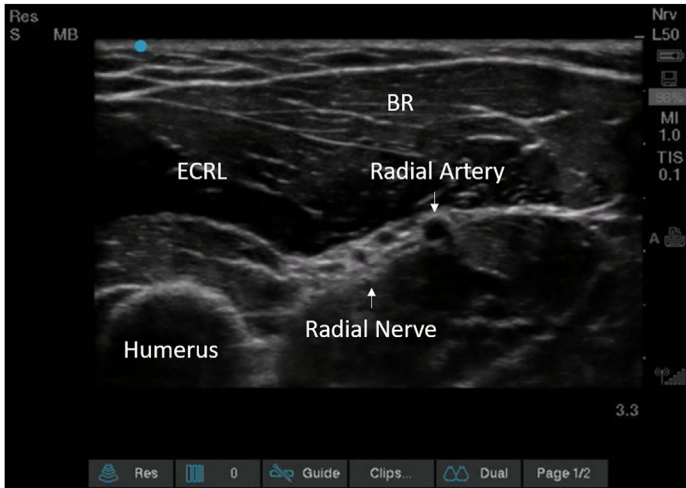


Fig. 8. The radial nerve is lateral to the radial artery and below the extensor carpi radialis longus (ECRL) and brachioradialis (BR) at the level of the proximal forearm.



Fig. 9. The ulnar nerve is medial to the ulnar artery.

The radial nerve lies lateral to the radial artery in the posterolateral forearm. Place the transducer in a transverse orientation over the radial artery on the volar aspect of the distal forearm. Slide the transducer proximally until you can visualize the nerve separating from the artery in the mid-to-proximal forearm (**Fig. 8**). Alternatively, you can find the nerve more proximally in the supracondylar region above the lateral aspect of the elbow, in the fascial plane between the brachioradialis and the brachialis muscles. The block can be performed at any level between the lateral elbow and distal wrist.

The ulnar nerve lies medial to the ulnar artery in the anteromedial forearm. Place the transducer on the volar surface of the distal forearm overlying the ulnar artery. Slide the transducer proximally until you can visualize the nerve separating from the artery in the mid-to-proximal forearm (**Fig. 9**).

Identify the target nerve and create a small anesthetic skin wheal approximately 1 cm lateral to the probe, marking the needle entry point. Insert a 1.5-inch block needle

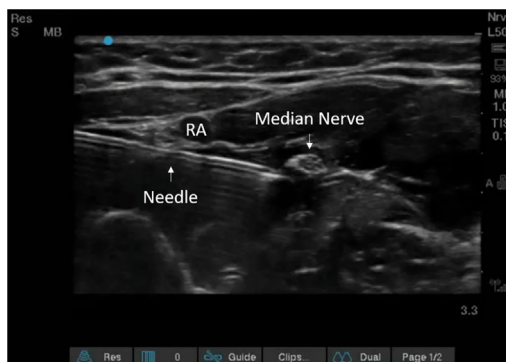


Fig. 10. Hypoechoic anesthetic surrounding the median nerve. Note needle entry below the radial artery (RA).



Fig. 11. Hypoechoic anesthetic surrounding the ulnar nerve.

using an in-plane approach for all 3 forearm nerve blocks. To block the median nerve, enter the skin from the side most comfortable and accessible to the operator. To block the radial nerve, enter the skin from a direction radial to the probe. To block the ulnar nerve, enter the skin from a direction ulnar to the probe. Inject 3 to 5 mL of local anesthetic into the fascial plane containing the nerve. Hypoechoic fluid should surround the nerve; however, full circumferential spread is not required (**Figs. 10 and 11**, **Videos 3 and 4**).

Truncal Blocks

Serratus anterior plane block

Indications. The serratus anterior plane block (SAPB) is commonly used for treatment of rib fractures in the ED. Rib fractures are associated with high morbidity rates due to resultant pneumonia or respiratory failure.¹⁷ The use of the SAPB for analgesia can improve respiration and compliance with incentive spirometry.¹⁸ Unlike the erector spinae plane block (ESPB), the SAPB can be performed with the patient lying supine, making it suitable for immobile patients, such as patients with cervical spine injuries. The SAPB can also be used to treat other painful conditions of the hemithorax such as herpes zoster pain or burns.¹⁹



Fig. 12. The thoracodorsal artery (TDA) and vein (TDV) are identified in the fascial plane between the latissimus dorsi (LD) and the serratus anterior (SA) muscles.

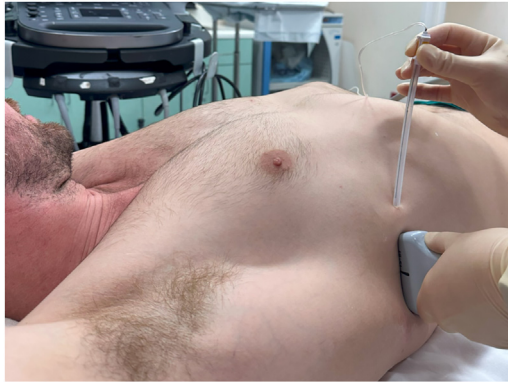


Fig. 13. Anterior approach to the serratus anterior plane block with patient supine.

Anatomy. The SAPB provides analgesia to the anterior and lateral hemithorax, with possible extension to the posterior hemithorax, by targeting the lateral cutaneous branches of the intercostal nerves. Studies suggest that the long thoracic, intercosto-brachial, and thoracodorsal nerves may also be blocked. However, the clinical significance remains uncertain. The SAPB can target either the fascial space between the latissimus dorsi and the serratus anterior, or the serratus anterior and the rib.²⁰ In patients with thin muscle layers (eg, elderly, cachectic), differentiating the fascial plane between muscle layers can be difficult. In these cases, we commonly place anesthetic just superficial to the rib instead of between the serratus anterior and latissimus dorsi.

Technique. Position the patient in a supine or lateral position with the unaffected side down. Place a linear transducer in the mid-axillary line over the desired rib level. Identify the rib, serratus anterior, latissimus dorsi, pleural line, and if present, the thoracodorsal artery (Fig. 12). Position the transducer such that the rib lies deep to the serratus anterior on the ultrasound screen.

The needle entry can be either anterior (Fig. 13) or posterior (Fig. 14) to the transducer using an in-plane approach, depending on comfort and patient positioning. Advance the block needle at a 30° to 45° angle between the serratus anterior and



Fig. 14. Posterior approach to the serratus anterior plane block with patient on lateral decubitus position.

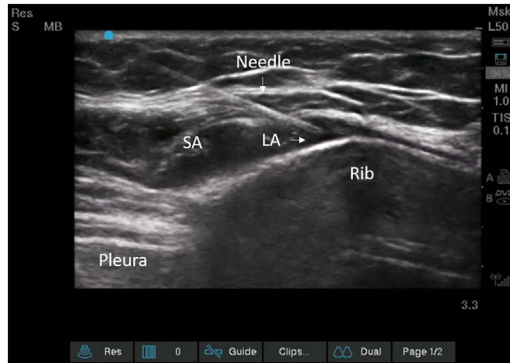


Fig. 15. Local anesthetic (LA) injection targeting the fascial plane between the serratus anterior (SA) and the rib.

the latissimus dorsi, or if targeting the deeper fascial plane, until the needle tip touches the rib (**Fig. 15**). Use normal saline to hydrodissect open the fascial plane (**Video 5**). Administer local anesthetic staying within weight-based dosing recommendations. Consider using color Doppler if concerned for the presence of a vascular structure. Take caution to avoid the thoracodorsal artery and the pleural space.

Erector spinae plane block

Indications. The ESPB provides analgesia to the hemithorax in a dermatomal distribution above and below the level of injection with variable spread, though generally up to 3 rib spaces in each direction.²¹ While the exact mechanism of action is debated, some postulate that the ESPB blocks sympathetic fibers, in addition to dorsal and ventral rami, thereby relieving visceral pain.²² Given the potential broad distribution of analgesia, the ESPB has a wide range of indications for painful conditions involving the thoracoabdominal area. The most common indication in the ED is rib fractures. Since its introduction, innovative clinicians are finding an expanding list of indications where it may be used successfully to not only treat traumatic injuries but also visceral pain from conditions like pancreatitis, appendicitis, and metastatic cancer.²³

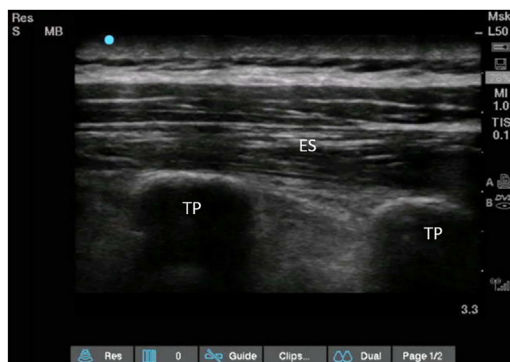


Fig. 16. The erector spinae (ES) muscle seen on top of the rectangularly shaped transverse process (TP).

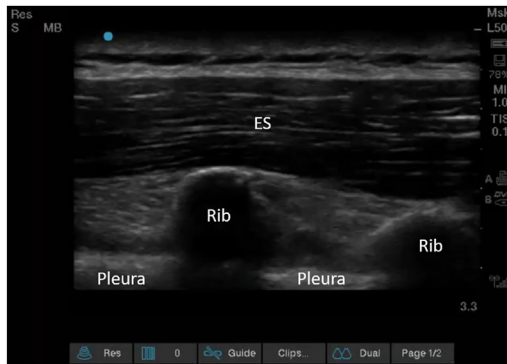


Fig. 17. The erector spinae (ES) muscle seen on top of the rounded contour of the rib.

Anatomy. The ESPB is a fascial plane block between the erector spinae muscle and the transverse processes. The erector spinae muscles run craniocaudally over the transverse processes. The multi-dermatomal distribution of analgesia is due to the cranial and caudal spread of the anesthetic within the fascial plane, which has been shown to spread several spinal levels above and below the needle entry point.²⁴ Needle entry location can be adjusted to target the specific spinal level associated with the painful pathology (eg, T8 for treatment of ureteral colic).²⁵

Technique. The ESPB may be performed with the patient either prone, sitting upright, or in lateral decubitus; however, we have found the lateral decubitus position to be the most difficult for achieving optimal needle visualization. Either the linear or curvilinear transducer may be used for the ESBP and should be selected based on the patient's body habitus. Place the transducer with the probe maker oriented cephalad. Start with the probe in longitudinal orientation over the ribs, midway between the scapula and the spine at the intended level of the injection. Slide the transducer medially over the costotransverse junction. Note the transverse process will have a more superficial, wider, and rectangular appearance (Fig. 16) compared to the more rounded rib (Fig. 17, Video 6). If the transducer is placed too medially, the deeper lamina will be seen. The erector spinae muscle lies directly over the transverse process.



Fig. 18. Needle positioning using a cranial in-plane approach.



Fig. 19. Needle positioning using a caudal in-plane approach.

The needle entry can either be cranial (**Fig. 18**) or caudal (**Fig. 19**) with respect to the ultrasound probe using an in-plane approach depending on comfort and patient positioning. Advance the block needle at a 30° to 45° angle using an in-plane approach through the erector spinae muscle until the needle tip reaches the transverse process. In our experience, targeting the needle tip at the edge of the transverse process allows for easier hydrodissection of the fascial plane. Use normal saline to hydrodissect open the fascial plane (**Fig. 20**, **Video 7**). Administer local anesthetic, staying within weight-based dosing recommendations.

Lower Extremity Blocks

Fascia iliaca plane block

Indications. The fascia iliaca plane block (FIPB) is a simple, effective nerve block that has been shown to improve pain control, decrease need for breakthrough analgesia, and decrease risk of delirium in patients with hip fractures in the ED.²⁶ The most common indication for the FIPB is femur fractures including: femoral head, femoral neck, intertrochanteric, and femoral shaft fractures. In patients with distal femur fractures and a high risk of developing compartment syndrome, orthopedic consultation should be performed before performing this block.

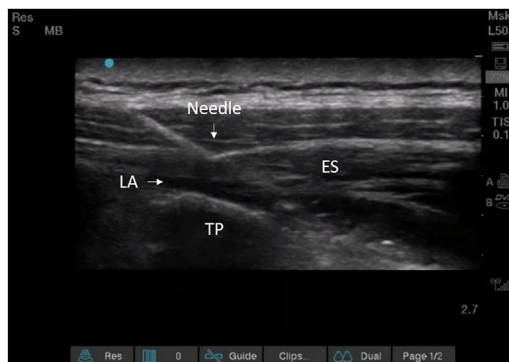


Fig. 20. Local anesthetic (LA) seen as anechoic fluid separating the erector spinae (ES) muscle from the transverse process (TP).

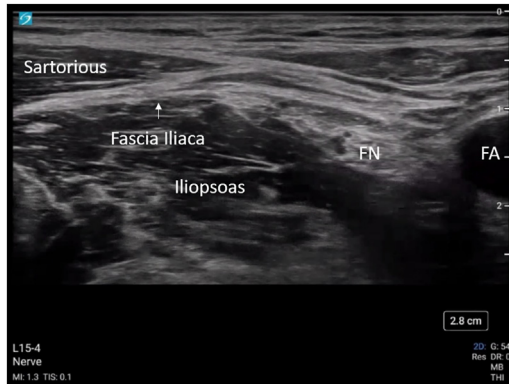


Fig. 21. The femoral nerve lies below the fascia iliaca and lateral to the femoral artery.

Anatomy. The FIPB produces a sensory and motor block of the femoral, lateral femoral cutaneous nerves, and possibly the obturator and genitofemoral nerves.^{27,28} The expected distribution of analgesia will include the femur, anterior thigh, medial knee, and medial tibia. This block has poor obturator innervation and does not provide analgesia to the medial pelvis (pubic rami fractures, etc.).²⁹ The target for this plane block is the potential space just deep to the fascia iliaca, which covers the femoral nerve. The FIPB can be performed using either an infra-inguinal or supra-inguinal approach. In our opinion, the anatomic landmarks for the infra-inguinal approach are easier to identify, therefore we will only describe this approach. The fascia iliaca lies deep to the fascia lata and the sartorius muscle, and superficial to the iliopsoas muscle. The most important structure to avoid is the femoral artery which is just medial to the femoral nerve.

Technique. Place the linear transducer along the inguinal crease and slide the transducer medially until the femoral artery and vein have been identified. The femoral nerve is lateral to the artery and deep to the fascia iliaca (Fig. 21). Of note, the block should be performed proximal to the femoral artery bifurcation. Optimize the view by placing the femoral artery on the edge of the screen to allow for needle path visualization.



Fig. 22. The transducer is positioned along the inguinal crease and the block needle is advanced using a lateral to medial in-plane approach.

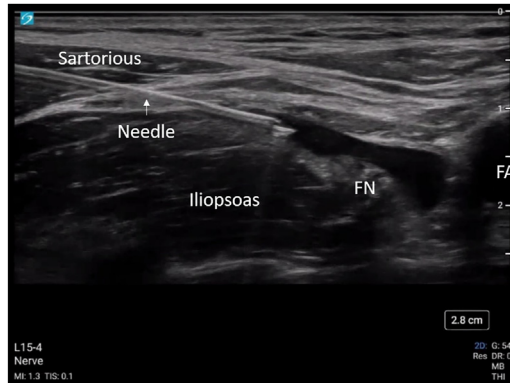


Fig. 23. Local anesthetic tracking above the femoral nerve, situated between the fascia iliaca and iliopsoas muscle, and lateral to the femoral artery.

Advance the block needle using an in-plane approach (Fig. 22) through the fascia iliaca, lateral to the femoral nerve. Maintain the needle tip away from the femoral nerve to avoid nerve injury. A popping sensation may be felt when passing through the 2 fascial planes. Use normal saline to hydrodissect open the fascial plane. The fascia iliaca will unzip, with saline spreading both lateral and medial to the needle tip (Fig. 23, Video 8). Administer local anesthetic, staying within weight-based dosing recommendations.

Distal sciatic nerve block in the popliteal fossa

Indications. The distal sciatic nerve block, also known as the popliteal sciatic or popliteal fossa nerve block, can be utilized to provide analgesia to the distal leg except for the medial aspect supplied by the saphenous nerve. Most common indications include ankle fractures, ankle dislocations, Achilles tendon rupture, burns distal to the knee, and traumatic injuries to the foot.³⁰ The most important contraindication to consider is the risk of compartment syndrome from a high mechanism injury (eg, proximal or midshaft tibial fractures, calcaneal compression fractures).



Fig. 24. Needle positioning with patient supine using a lateral to medial in-plane approach.



Fig. 25. Needle positioning with patient prone using a lateral to medial in-plane approach.

Anatomy. The distal sciatic nerve bifurcates into the common peroneal nerve and the tibial nerve at approximately the level of the popliteal fossa. The distal sciatic nerve innervates the entire lower leg below the knee, except for a portion of the medial leg and foot that is supplied by the saphenous nerve. The distal sciatic nerve is deep and medial to the biceps femoris, lateral to the semimembranosus, and superficial to the femur. The sciatic nerve is commonly hyperechoic in this region and is found lateral to the popliteal artery and vein.

Technique. The block may be performed with the patient supine (Fig. 24), prone (Fig. 25) or on their side, based on patient comfort. We recommend the prone position if possible as it improves the angle of the popliteal fossa, makes probe manipulation easier, and is often more stable compared to the lateral decubitus position.

Place a linear transducer in the popliteal fossa to identify the distal sciatic nerve, popliteal vein, and popliteal artery (Fig. 26). Slide the transducer to identify the nerve at the level of its bifurcation into the tibial and common peroneal nerves (Fig. 27). Use color Doppler and compression to confirm no vascular structures are in the needle path.

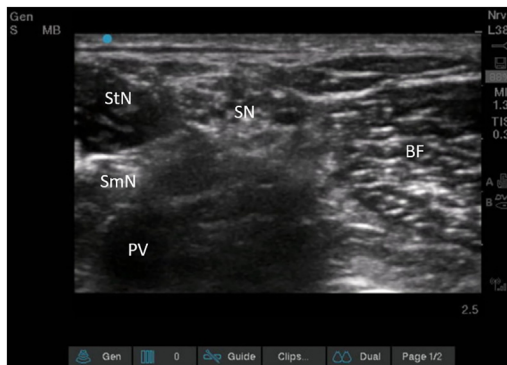


Fig. 26. The sciatic nerve (SN) is found superior to the popliteal vein (PV), bordered laterally by the biceps femoris (BF) and medially by the semitendinosus (StN) and semimembranosus (SmN).

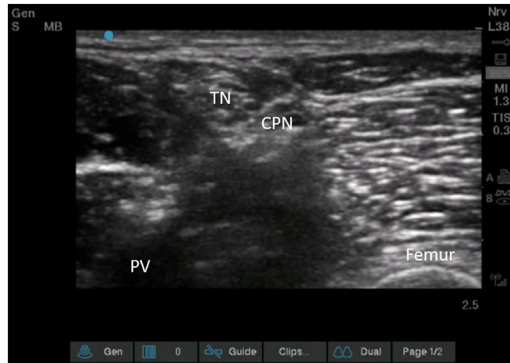


Fig. 27. The sciatic nerve bifurcates into the tibial nerve (TN) and the common peroneal nerve (CPN) at the level of the popliteal fossa. Note the popliteal vein (PV) inferior to the nerves.

We recommend a lateral-to-medial in-plane approach. Advance the block needle using an in-plane approach toward the common sciatic nerve sheath just proximal to the bifurcation. Use normal saline to hydrodissect open the fascial plane (**Fig. 28**, **Video 9**). Fluid should be seen spreading within the sheath and separating the tibial and common peroneal nerves. Administer local anesthetic, staying within weight-based dosing recommendations.

Tibial nerve block

Indications. The tibial nerve block provides analgesia of the calcaneus and the sole of the foot. This block will not provide analgesia to the ankle. Common indications of the tibial nerve block include calcaneal fractures and injuries to the sole of the foot including lacerations, abscesses, burns, infections, frostbite, and foreign body removal.^{31,32} We recommend consulting an orthopedist before performing this block in patients with a calcaneal fracture as compartment syndrome develops in approximately 10% of patients with calcaneal fractures.³³

Anatomy. The tibial nerve travels in a neurovascular bundle with the posterior tibial artery and 2 posterior tibial veins. The tibial nerve can be found posterior to the medial



Fig. 28. Local anesthetic (LA) can be seen surrounding the sciatic nerve (SN).

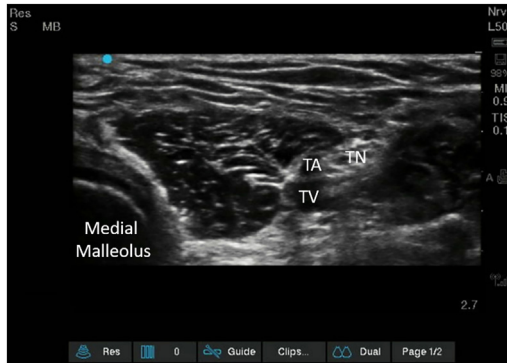


Fig. 29. The tibial nerve (TN) is posterior to the posterior tibial artery (TA) and tibial vein (TV).

malleolus and anterior to the Achilles tendon. The neurovascular bundle is medial to the flexor hallucis longus muscle and lateral to the tibialis posterior and the flexor digitorum longus muscle.

Procedure. The block can be performed with the patient either supine with the hip flexed and externally rotated, or on their side with their leg to be blocked on top to expose the medial ankle. Place a linear transducer perpendicular to the tibia over the medial malleolus to identify the posterior tibial artery and vein. The nerve lies posterior to the vessels. Slide the transducer to find an optimal location where the posterior tibial artery and nerve can be visualized (**Fig. 29**).

Either an out-of-plane (**Fig. 30**) or in-plane (**Fig. 31**) approach can be utilized. If an out-of-plane approach is utilized, use a centerline to guide the needle at a steep angle toward the tibial nerve. If an in-plane approach is used, enter posteriorly just medial to the Achilles tendon. A posterior approach will avoid the tibialis posterior and the flexor digitorum longus. Use normal saline to hydrodissect open the fascial plane surrounding the nerve. Fluid should spread around the nerve. Inject 5 to 7 mL of local anesthetic using a block needle. If a patient feels a shooting sharp pain, retract the needle slightly before injecting again to avoid intraneural injection.



Fig. 30. Needle positioning with patient on lateral decubitus using an out-of-plane approach.



Fig. 31. Needle positioning with patient on lateral decubitus using an in-plane approach.

SUMMARY

USGNBs are becoming more common in clinical EM practice. Along with being an excellent part of a multimodal pain regimen in an acutely injured ED patient, USGNBs may be an ideal alternative to time consuming procedural sedation.

CLINICS CARE POINTS

- Avoid performing UGNBs on patients with preexisting neurologic deficits in the distribution of the nerve block to be performed.
- Use color Doppler to differentiate nerves from surrounding vascular structures.
- Inject small aliquots of normal saline to hydro-dissect open the fascial planes surrounding target nerves prior to administration of local anesthetic.
- Avoid LAST by adhering to weight-based anesthetic dosing limits, maintaining clear needle tip visualization during the entire procedure, and aspirating before injecting anesthetic in aliquots of 3 to 5 mL.
- Be aware that larger volume ultrasound-guided interscalene (>5 mL) and supraclavicular (>20 mL) brachial plexus blocks increase the risk of phrenic nerve paralysis and Horner syndrome.

DISCLOSURE

Dr A. Nagdev is senior director of education at Exo, Inc.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.emc.2024.05.013>.

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